ISSN 0228-4111

NEWSLETTER OF THE LONDON CHAPTER,
ONTARIO ARCHAEOLOGICAL SOCIETY
55 Centre Street, London, Ontario N6J 1T4

December, 1990

90-8

This month Speaker's Night is:

MEMBER'S NIGHT

This year on member's night we offer a wide assortment of presentations for your entertainment and enjoyment (not as good as last year's film of Jim Wilson "finding" a point in his midden profile, however!). Speaker Night is Thursday February 14th, starting at 8 PM at the Museum of Indian Archaeology. Hope to see you there.

The Untold "Story": The Early 19th Century Story Site in Brant County
Bev Morrison

Guiding Girls and Other Volunteers: The London Chapter Survey of a Girl Guide Summer Camp in Elgin Co.
Tom Arnold

Iroquoian Longhouse Construction and Post Placement: The Yugoslavian Perspective
Rosemary Prevec

Getting "Stiff"-ed: Some Thoughts on Bone Fossilization
Megan Cook

ANNUAL RATES

Individual	$15.00
Family	$18.00
Institutional	$21.00
Subscriber	$15.00

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EXECUTIVE REPORT

One continuing concern of the Executive is the Chapter's ability to exist in a single place. As has been reported previously, we are not sure if our present residence, 55 Centre Street, may one day no longer provide the Chapter with office space. Consequently, the need to find a new fixed address still exists, and the Executive has been looking into possibilities. What is needed is a place which allows access 24 hours, 7 days a week; space enough to store our computer, files and publications; and is functional enough to allow us to produce KEWA, hold Executive meetings, and perhaps even conduct lab nights. While no prospects are forthcoming (anyone have any ideas?), as a first step to weaning ourselves from 55 Centre Street the Executive has decided to get a Post Office Box to serve as the Chapter's official mailing address. Of course, due to the amount of stationary with the old address on it, as well as years of association with it, mail will continue to be collected for the Chapter at 55 Centre Street. The new address is P.O. Box 2574, Station B, London Ontario, N6A 4G9.

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THE CAA'S ARE COMING, THE CAA'S ARE COMING!!!

London will play host to the 1992 Canadian Archaeological Association annual conference, from Wednesday May 6th to Sunday May 10th. A lot of work is needed to organize the conference and make sure things go smoothly. An organizing committee for the conference has been struck, and is looking for volunteers to help in the areas of logistics; promotion; fund-raising; organizing sessions; trips and social events; and administration (ok, just about everything!). If you are interested in helping organize the CAA conference, please contact Neal Ferris at 432-2165 (nights) or 433-8401 (days).

* * *

SOCIAL REPORT

As we turn the corner on winter, and start the slow move to spring, its time to start thinking about possible field projects for Chapter members this summer. If anyone would be interested in running weekend or short-term projects for Chapter members, situated nearby London (no more than an hour's drive), please contact the Executive.

Heritage week is coming up again in February, and once again the Chapter is planning to offer displays and artifact identifications at the downtown library. If anyone is interested in helping out, please contact Chapter Vice-President Pat Weatherhead. This year, thanks to the OAS parent body, the Chapter will also be exhibiting a new display system during Heritage week. This portable stand allows us to show pictures and blurbs describing archaeology, the OAS and the London Chapter to the general public. After heritage week expect to see the display at local area malls and events.

EDITOR'S NOTE

This month we offer an article from Jim Pengelly, who provides a review of the effects of Lake Erie water level rises during prehistory on the southern Niagara peninsula. Or, one might consider this article as providing some good investment advice: where to buy good lake frontage cheap before the next flood! Also, reviving an old treat, we include in this month's newsletter a Point Type sheet. We know how popular these are, and we would produce more, if only we could get additional submissions from the membership (hint! hint! hint!).

Southern Niagara: Ephemeral Lakes, Sporadic Outlets, Transitional Environments and Native Populations Under Stress

James W. Pengelly

Introduction

> Love of birthplace, no matter how inhospitable it may appear to strangers, is quite possibly a universal characteristic.
>
> Bennet 1978

> This land is where we belong - it is God's gift to us and has made us as we are. This land is where we are at home, we know its way: and the things that happen here are known and remembered, so that the stories the old people told are still alive here. This land is needed for those who will come after us...This land is the place where to find all that is provided for us - food for hunting and fishing, and farms, building and tool materials, medicines. Also the Spirits around us know us and are friendly and helpful. This land keeps us together - we come to understand that we are not just a few people belonging to a homeland. If we had to move, we would be lost to those who remain in other villages. Those who moved would be strangers to the peoples and spirits and places where they are made to go.
>
> Goldsmith & Hildyard 1984

The two statements quoted above reflect the bond that people, especially Native people, have for the land they occupy. The thought of having to move out of known territory and known subsistence patterns into a new area caused social upheaval and stress in the people affected. During the last 11,000 years, the Native occupants of the southern Niagara Peninsula in Ontario have been forced to relocate their territories twice due to flooding of a vast area by rising Lake Erie levels (Fox and Pengelly 1990). This paper will examine the causes of these lake level rises and some of the changes they caused in Native habitation patterns, resource procurement and possible health effects.

Lake Erie Water Level Changes and the Southern Niagara Peninsula

When studying the archaeological evidence for past Native occupation of the Niagara Peninsula, it can be very easy to look at the modern landforms surrounding a site and deduce the reasons why people lived there. However, if we assume that land surface has not changed very much in the past 12,500 years, since the glaciers left, we fall into a fatal trap. While we know from the pollen record that there was an ordered progression to the types of vegetation that grew in the peninsula since glaciation (Terasmae 1980), and can be fairly sure what types of plants grew at each time period, we cannot assume that the rivers have always flowed in the same path as they do today. As a matter of fact, recent studies have proven that the Niagara Peninsula underwent two major changes due to dramatic rises in the level of Lake Erie, which inundated large areas and reduced the amount of land surface Native cultures could occupy. The first occurence, and the most dramatic, occured at about 11,000 to 10,500 B.P., and the second between 5,500 and 3,900 B.P. (Pengelly 1990).

In order to understand the reasons for these two lake level rises, it is essential to review several controlling factors which determined those rises. This includes i) the overflow (discharge) of water through Lake Erie from the upper Great Lakes; ii) the

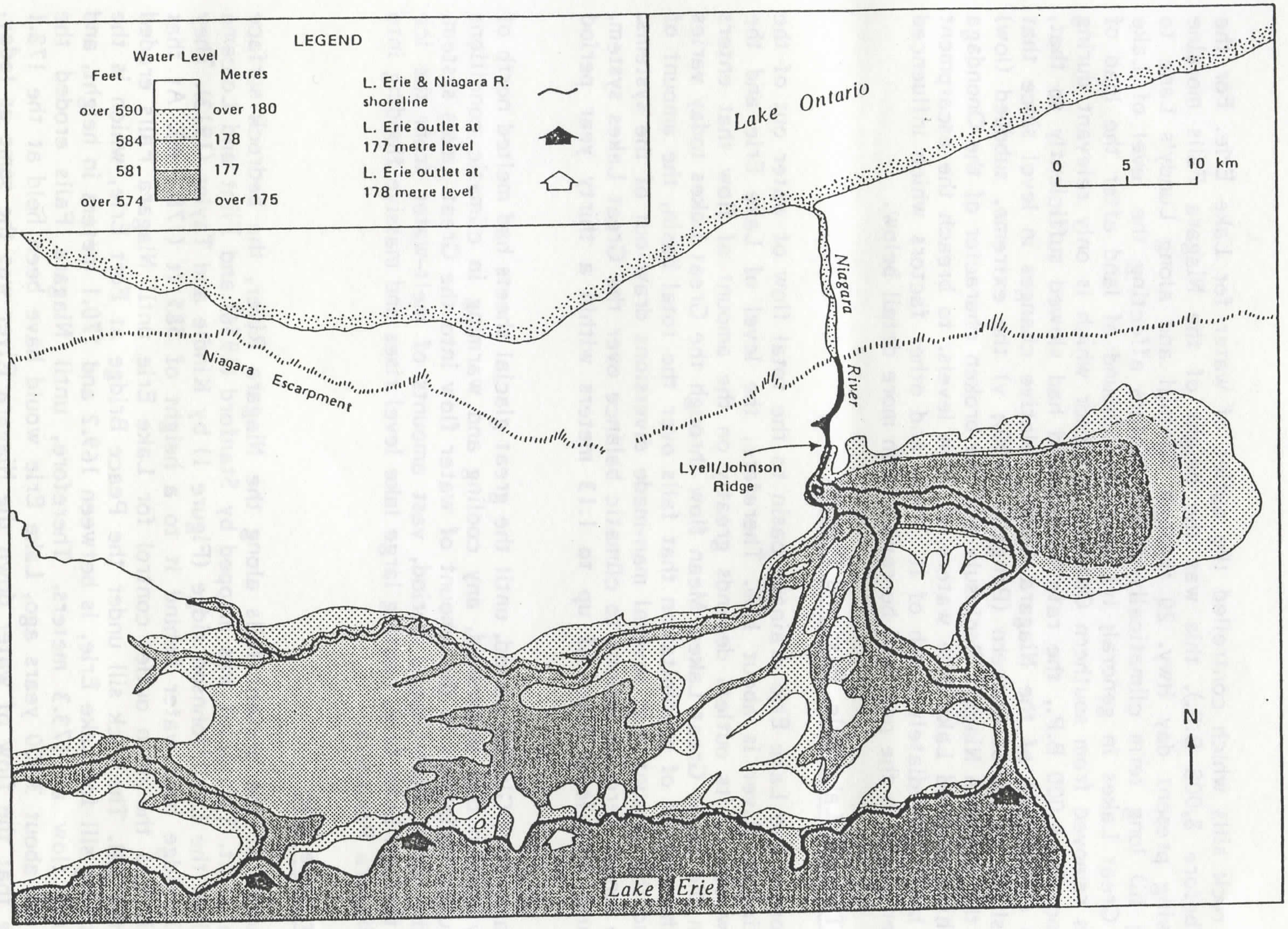


Figure 1: Lake Wainfleet (Nipissing Phase) - Lake Levels Due to Nipissing Rise in Lake Erie, ca. 5,500 - 3,900 B.P. From Tinkler et al 1990.

height of the rock sills which controlled the outlet of water for Lake Erie. For the early period (before 8,000 B.P.), this was the height of the Niagara Falls moraine (roughly following present day Hwy. 20 through Fonthill and along Lundy's Lane to Niagara Falls); iii) long term climatically-driven factors affecting the level of Lake Erie, and the Great Lakes in general; iv) isostatic rebound of land after the load of glacial ice was removed from southern Ontario, a factor which is only relevant during the early period. By 4,000 B.P., the rate of rebound had slowed sufficiently so that, within 100 km either side of the Niagara Gorge, relative changes in level since that time are too slight to be of concern (Pengelly 1990); v) the extreme, subdued (low) topography of the southern Niagara Peninsula and the broken character of the Onondaga Escarpment, which enabled Lake Erie waters, at high levels, to breach the escarpment and flood the lands immediately north of it. These and other factors which influenced Lake Erie water levels in the past will be reviewed in more detail below.

The Overflow Through Lake Erie, Past and Present

The contribution of the Lake Erie drainage basin to the total flow of water out of the present day Niagara River is about 13%. Therefore, the level of Lake Erie and the amount of flow out of its outlets depends greatly on the amount of flow that enters that basin from the upper Great Lakes. Mean flow through the Great Lakes today varies according to the amount of precipitation that falls over the total basin, the amount of evaporation and the amount that several man-made diversions draw out of the systems. There are also longer term variations to climatic balance over the Great Lakes system, which can cause lake level rises of up to 1.13 meters within a thirty year period (Horton 1927).

In the early Post Glacial period, until the great glacial sheets had melted north of the James Bay/Hudson Bay watershed, any cooling and warming in climatic conditions would have caused variations in the amount of water flow into the Great Lakes system. Also, during the early Post-Glacial period, vast amounts of melt-water from the ice sheets flowed through Lake Erie, causing large lake level rises and massive flooding into the southern Niagara Peninsula.

Outlet Sills for Lake Erie

About 3 km north of the present falls along the Niagara River, the bedrock surface reaches a high point. This point was mapped by Stanford (1956) and Flint and Lolcama (1985), and called the Lyell/Johnson ridge (Figure 1) by Kindle and Taylor (1913). They also stated this ridge held water behind it to a height of 585 ft (178.1 m). At that height, this sill was the main outlet control for Lake Erie until Niagara Falls eroded back through the sill. The rock sill under the Peace Bridge at Fort Erie, which is the current, controlling sill for Lake Erie, is between 169.2 and 170.1 meters in height, and holds Lake Erie flow at 173.3 meters. Therefore, until Niagara Falls eroded the Lyell/Johnson sill about 3,900 years ago, Lake Erie would have been held at the 178.1 level, assuming that the flow of water down the Niagara River was the same as today. As will be seen later, this flow has not been constant.

Glacial Lake Agassiz Outflow

Lake Agassiz (Figure 2) was a huge lake of impounded water, held between the retreating ice sheets and rising land to the south of it during the early Post Glacial period. Some of the flows out of Glacial Lake Agassiz into the Great Lakes system have been studied by Teller (1985), Teller and Thorleifson (1983), and Lewis and Anderson (1989). From time to time during its existence, lower divides (watersheds) appeared on

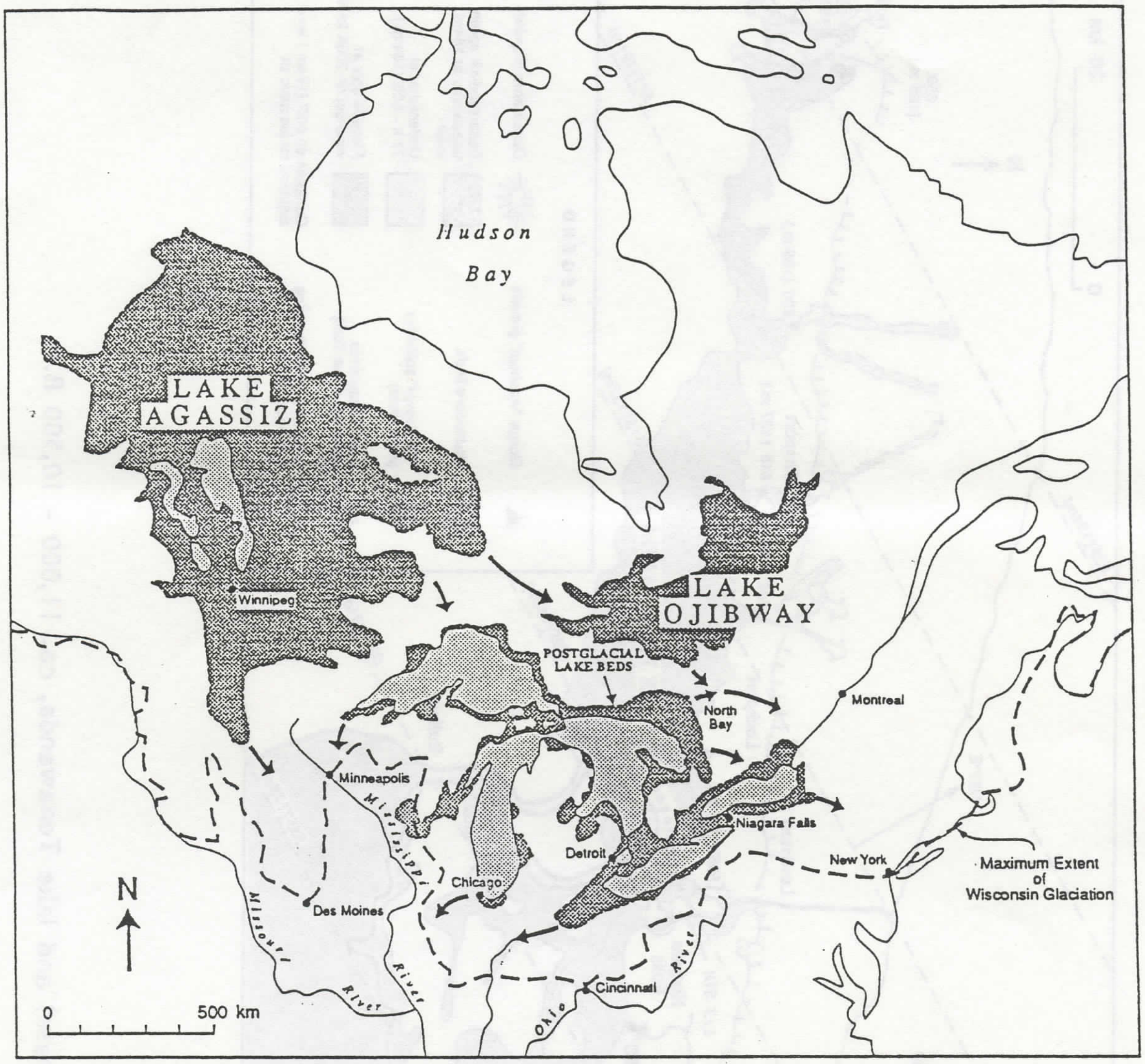


Figure 2: Lake Agassiz, the Great Lakes, and Their Various Outlets. From Tinkler et al 1990.

the eastern margin of Lake Agassiz, and when this happened large quantities of water discharged out through Lake Nipigon in the Lake Superior basin. As much as 200,000 cumecs of water (40 times the Niagara River flow) were added to Superior over a period of about two years. The average flow rate out of Lake Agassiz when it was in equilibrium was 30,000 cumecs (Teller 1985; Lewis and Anderson 1989), raising water levels to about 182-185 meters (Figure 3). The resulting increase in Lake Erie levels as a result of this increased flow is referred to here as the Agassiz phase levels (Tinkler et al 1990).

Effects of Isostatic Rebound on Lake Erie Levels

Ever since the glacial ice sheets retreated out of the Great Lakes basin, the land has been springing back from the lower levels caused by the weight of the ice. Knowledge of early Lake Erie levels is complicated by a number of factors. In the first place, the

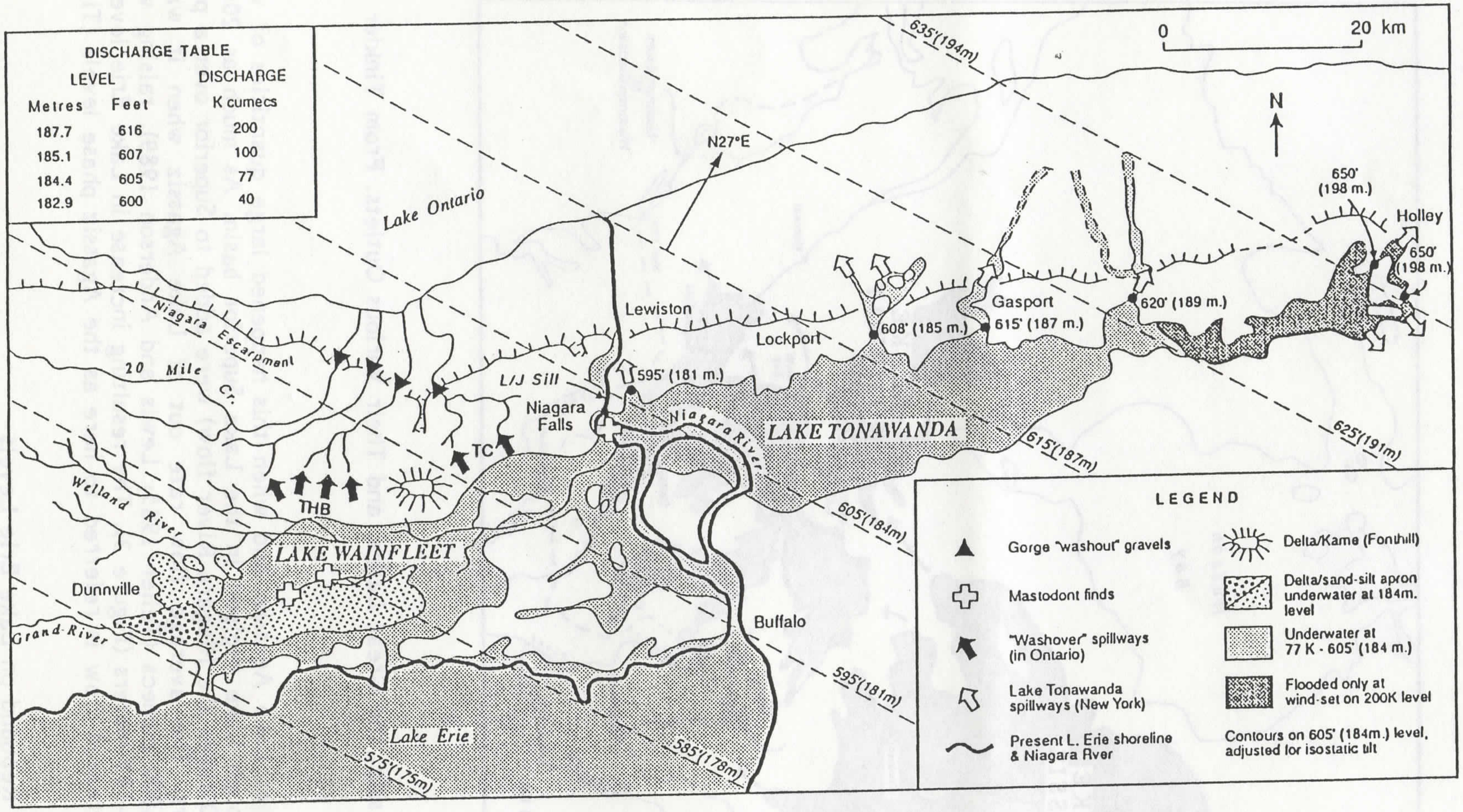


Figure 3: Lake Wainfleet (Agassiz Phase) and lake Tonawanda, ca. 11,000 - 10,500 B.P.
From Tinkler et al 1990.

topography of the Niagara Peninsula and the area extending into western New York State was systematically tilted as a consequence of the removal of the ice load. The east and north rose faster than the west and south, so that, for example, along the 100 km length of early Post Glacial Lake Tonawanda (Figure 4), the spillway at the east end of the lake is now over 15 meters higher than the spillway at the western end (Kindle and Taylor 1913).

Also, since flows through the Niagara River included a great deal of meltwaters from the North American ice sheet discharged into the Great Lakes basin, the amount that entered Lake Erie depended on how isostatic rebound affected the outsills controlling the flow of water from the upper Great Lakes. As well, in the last 5000 years no significant relative isostatic tilting within the study area either side of the Niagara River has been detected. Also, it is worth pointing out that, on a recent map of changes in level across the Great Lakes, both the Niagara River and Port Huron sills (the outlet control for Lake Huron) lie at the same isobase, and are therefore unaffected by any relative changes in water level (Clark and Persoage 1970).

The Subdued Topography of the Southern Niagara Peninsula

There are several areas along the north shore of Lake Erie that are only a couple of meters above the level of the present lake. If lake levels rose from 5 to 10 meters above present levels as a result of increased flows of water into the Erie basin at various times in the past, then these low areas would have been easily breached, allowing Lake Erie waters to flow through onto the low-lying plain north of the Onondaga Escarpment. This would have caused an extension of Lake Erie to form between the Escarpment and the Niagara Falls moraine/Fonthill kame lands, north of the Welland River. This flooded area is referred to here as Lake Wainfleet, although it was really a westward extension of Lake Tonawanda (Figures 1,3). Sometimes, both Wainfleet and Tonawanda were in existence at the same time, while at other times, as the eastern outlets of Lake Tonawanda rose due to isostatic rebound, causing the east end of the lake to dry up, only the west end of Lake Tonawanda and Lake Wainfleet existed. Figure 3 shows what the effect would have been if the Lake Erie basin had varied in level (177, 178 and 180 meters). Notice the difference in the amount of land that would have flooded with only a one meter rise in water level.

Lake Wainfleet and Niagara Falls

Lake Wainfleet appears to have been last in existence about 3,000 years ago. This evidence comes from peat and sediment cores obtained by the author from a number of locations in the former Lake Wainfleet region - in the Wignell Drain (east of Port Colborne), and from the Humberstone and Willoughby Bogs.

The 3.3 meter long core taken from the Wignell Drain (NTS-30L/14b-445485; Figure 5), taken within a kilometer of the present shoreline of Lake Erie, is especially instructive, for the top of the core (the present day land surface) is at a height of 175 meters, while the remainder of the core in below present lake levels. Thus, the area from where this core was taken would have been inundated if lake levels rose high enough to form Lake Wainfleet. Figure 5 shows the stratigraphy documented in the Wignell Drain core. Found about one meter below present day surface are a series of thin (no more than 0.25 cm in thickness) stratified layers of sand, peat and clay. This deposit overlaid the entire core site and varied in depth, with layers of silt and sand (implying shallow water and wave-driven currents), thin layers of peat (implying periods of drying out), and clay (implying periods of deeper water, probably frozen in winter, in order to settle out the clay deposit), all present. This complex layer of the core is

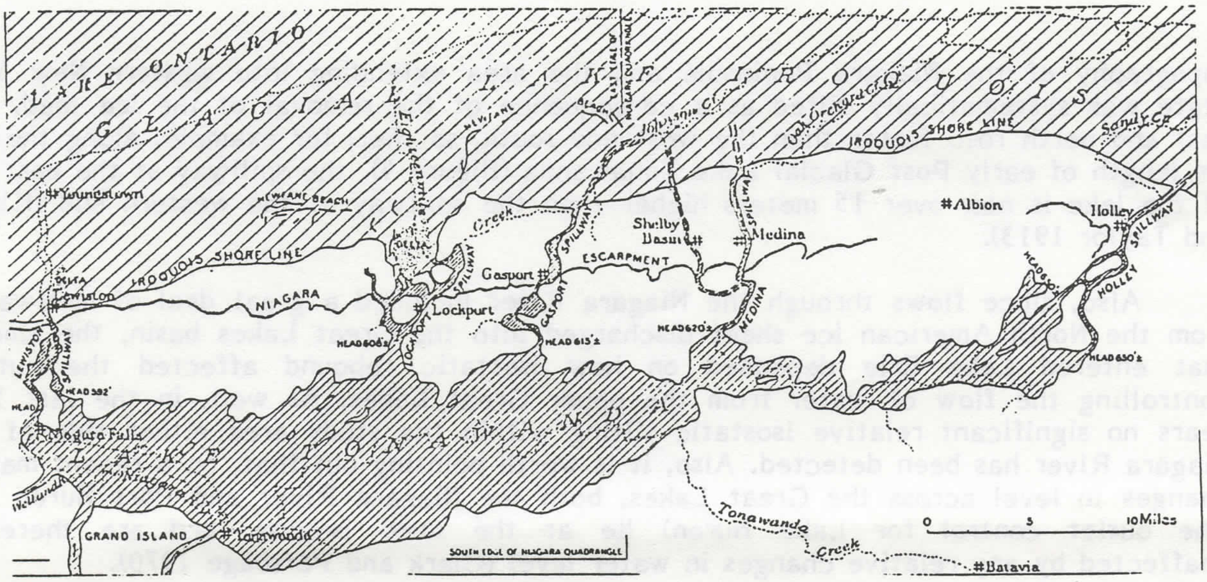


Figure 4: Lake Tonawanda and its Outlets to Glacial Lake Iroquois. Taken from Kindle and Taylor (1913).

bracketed by C-14 dates of 4,160 ± 120 B.P. (BGS-1388) below, and 3,900 ± 80 B.P. (BGS-1393) above. Above this level of thin deposits only peat was present, although every layer in the core contained small particles of sand which probably were blown in by wind from the nearby coastal, aeolian dune deposits (Pengelly 1990).

Below the complex, stratified layer of sand, peat and clay, are layers of peat, occasionally with silt and sand, while the deeper part of the core is suffused with clay. From this, it is deduced that the lower area represents the remains of a wet bog, sometimes flooded, but not part of an interior lake per say.

The bottom-most layer of the core consisted of a dense, grey clay with pollen in it suggesting the clay was laid down during a period of primarily a pine-spruce dominated vegetative zone. A C-14 date of 8,340 ± 160 B.P. (BGS-1392) was obtained from a peat layer immediately above this clay. However, this date does not agree with the pollen profile documented for the core.

On the basis of the evidence obtained from this core, augmented with similar data from the other cores taken for this study, it is believed that Lake Erie was much higher during the period 11,000 to 10,500 B.P., which would agree with the interpretations put forth by Teller (1985), who suggests that the Lake Agassiz outflow had reached the Erie basin at that time. It is worth mentioning here that during the Agassiz phase of Lake Erie and Lake Wainfleet, much of the outflow from Lake Agassiz was diverted out of the upper lakes past North Bay and down the Ottawa River. Therefore, the exact amounts and chronology of these flows, as they affected the Erie basin, are very hard to establish and were very much affected by isostatic rebound effects on the outlet sills for the upper Great Lakes.

Following the Lake Agassiz outflow, Lake Erie levels appear to have remained close to present levels for a long period of time. Levels then rose again during what is referred to here as the Nipissing phase (ca. 5,500 to 3,900 B.P.), identified by Larsen (1985). Why was this? As stated earlier, Kindle and Taylor (1913) recognized the

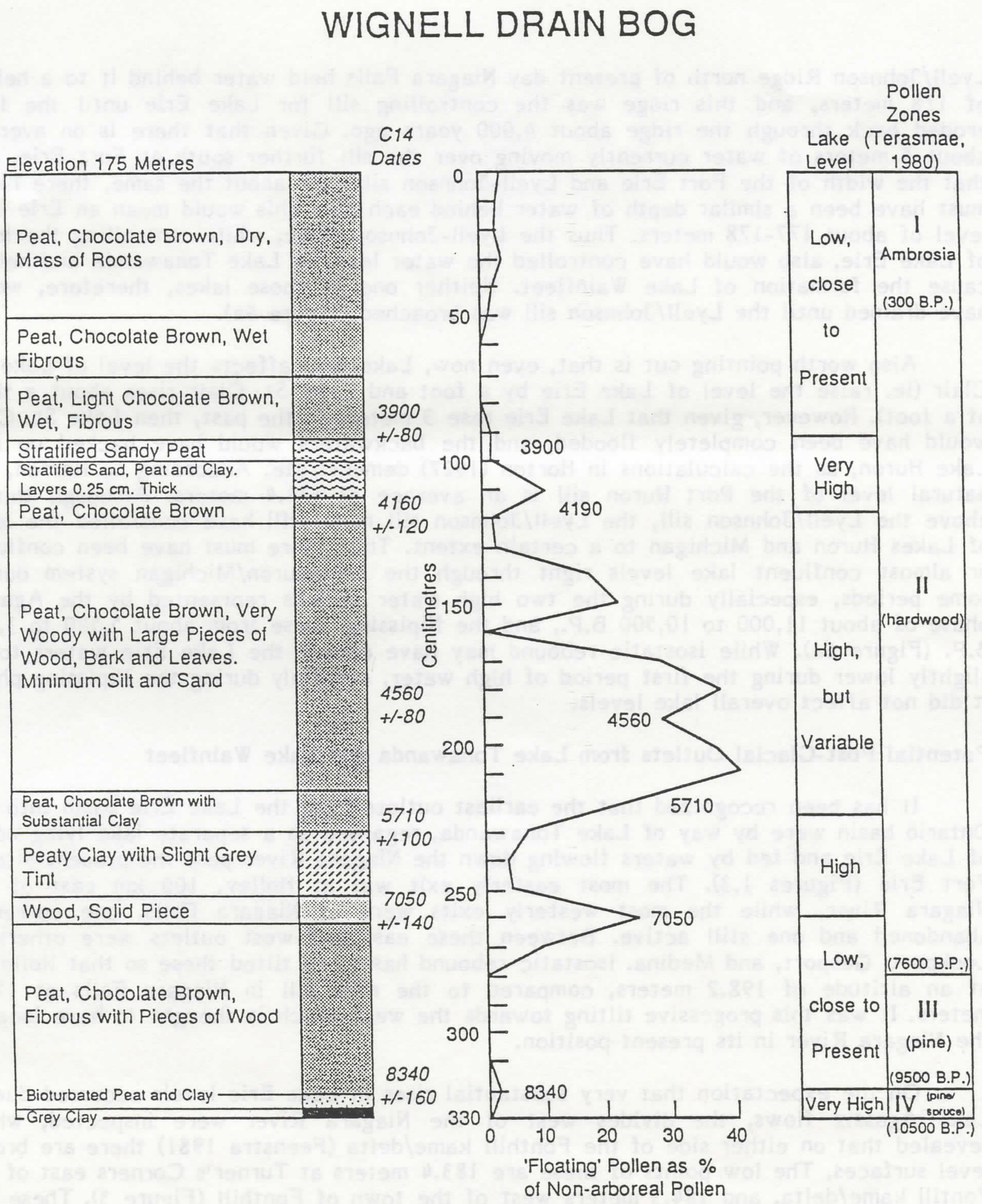

WIGNELL DRAIN BOG

Figure 5: Stratigraphy and Interpretation of the Wignell Drain Bog (Port Colborne, Ontario). Taken From Tinkler et al. 1990.

Lyell/Johnson Ridge north of present day Niagara Falls held water behind it to a height of 178 meters, and this ridge was the controlling sill for Lake Erie until the falls eroded back through the ridge about 4,000 years ago. Given that there is on average about 5 meters of water currently moving over the sill further south at Fort Erie, and that the width of the Fort Erie and Lyell-Johnson sills are about the same, there likely must have been a similar depth of water behind each sill. This would mean an Erie lake level of about 177-178 meters. Thus the Lyell-Johnson ridge, while controlling the level of Lake Erie, also would have controlled the water level in Lake Tonawanda and helped cause the formation of Lake Wainfleet. Neither one of these lakes, therefore, would have drained until the Lyell/Johnson sill was broached (Figure 6a).

Also worth pointing out is that, even now, Lake Erie affects the level of Lake St. Clair (ie. raise the level of Lake Erie by a foot and Lake St. Clair rises about a third of a foot). However, given that Lake Erie rose 3 meters in the past, then Lake St. Clair would have been completely flooded, and the backwaters would have backed up into Lake Huron, as the calculations in Horton (1927) demonstrate. According to Horton, the natural level of the Port Huron sill is an average of 174.4 meters. Although this is above the Lyell/Johnson sill, the Lyell/Johnson sill must still have controlled the level of Lakes Huron and Michigan to a certain extent. Thus there must have been confluent or almost confluent lake levels right through the Erie/Huron/Michigan system during some periods, especially during the two high water periods reprsented by the Agassiz phase of about 11,000 to 10,500 B.P., and the Nipissing phase from about 5,500 to 3,900 B.P. (Figure 6a). While isostatic rebound may have caused the Lake Erie waters to be slightly lower during the first period of high water, certainly during the Nipissing phase it did not affect overall lake levels.

Potential Post-Glacial Outlets from Lake Tonawanda and Lake Wainfleet

It has been recognized that the earliest outlets from the Lake Erie basin into the Ontario basin were by way of Lake Tonawanda, regarded as a separate lake lying north of Lake Erie and fed by waters flowing down the Niagara River past the present site of Fort Erie (Figures 1,3). The most easterly exit was at Holley, 100 km east of the Niagara River, while the most westerly exits were at Niagara Falls, one currently abandoned and one still active. Between these east and west outlets were others at Lockport, Gasport, and Medina. Isostatic rebound has since tilted these so that Holley is at an altitude of 198.2 meters, compared to the rock sill in Niagara Falls at 177.4 meters. It was this progessive tilting towards the west which is thought to have located the Niagara River in its present position.

On the expectation that very substantial rises in Lake Erie levels occurred due to Lake Agassiz flows, the divides west of the Niagara River were inspected, which revealed that on either side of the Fonthill kame/delta (Feenstra 1981) there are broad, level surfaces. The low points of these are 183.4 meters at Turner's Corners east of the Fontill kame/delta, and 184.3 meters west of the town of Fonthill (Figure 3). These had not been previously recognized as outlets from Lake Erie, although at Turner's Corners there is a shallow channel 200 meters wide across the divide. The surface of both the east and west outlets is a heavy lacustrine clay or clay/silt (Feenstra 1981, 1986), and most of the divide crest, which has extremely gentle slopes to the north and south, still exhibits the characteristic surface ribbing described by Loken and Leahy (1964). Thus, these outlets were not extensively scoured, and any water which passed over these divides must have had low velocities, certainly below that necessary to entrain any substantial quantities of clay and fine silt.

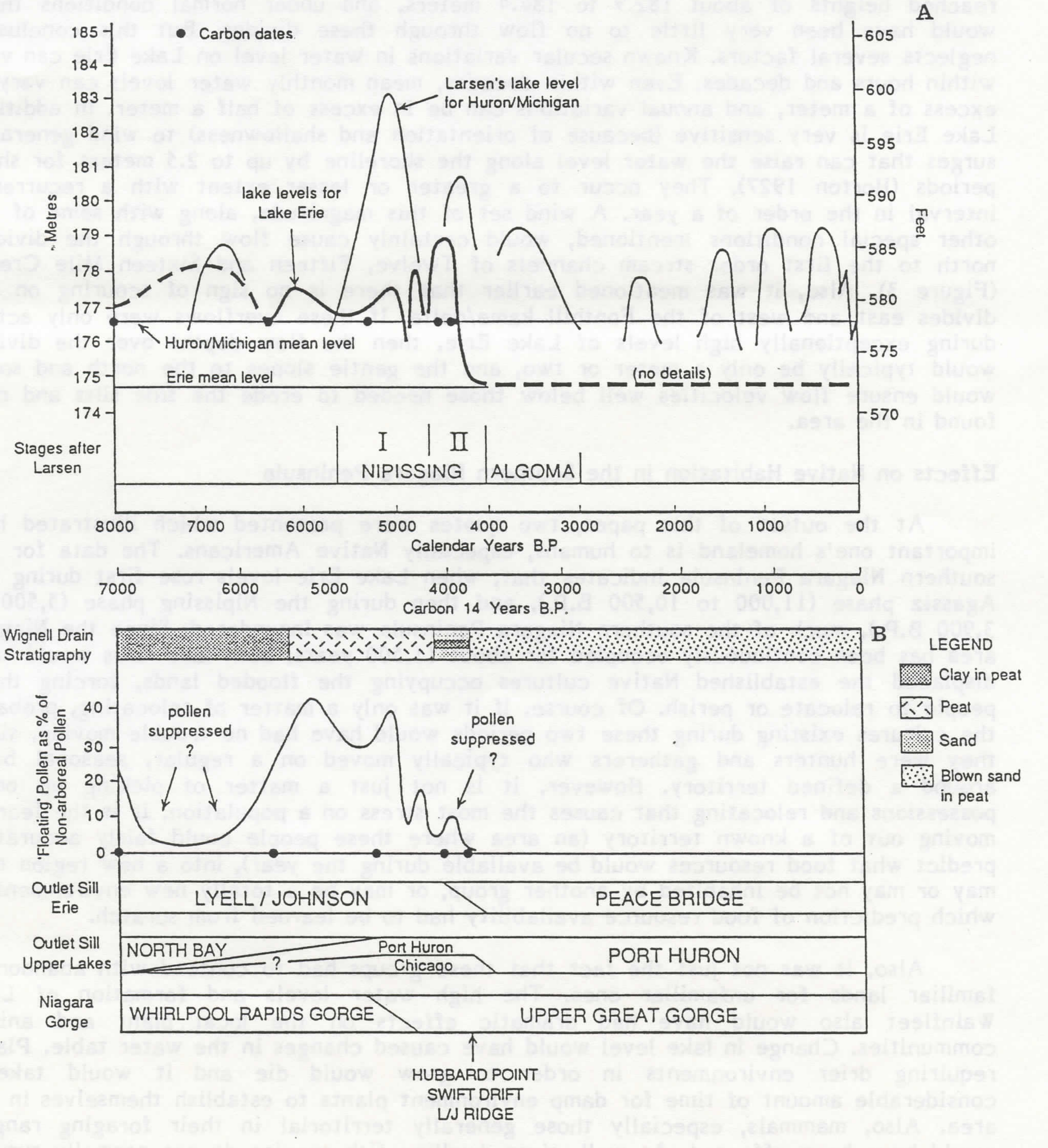


Figure 6: A- The Water Level Record for Lake Erie Related to Levels for Lakes Huron and Michigan. B- Wignell Drain Big Stratigraphy Compared With Sills in Use and Percent of Floating Pollen. Both Taken From Tinkler et al 1990.

When the impact of the flow of water from Lake Agassiz through the Erie Basin is calculated, it appears that the levels in Lake Wainfleet and Lake Tonawanda only reached heights of about 182.9 to 184.4 meters, and under normal conditions there would have been very little to no flow through these divides. But this conclusion neglects several factors. Known secular variations in water level on Lake Erie can vary within hours and decades. Even within decades, mean monthly water levels can vary in excess of a meter, and annual variations can be in excess of half a meter. In addition, Lake Erie is very sensitive (because of orientation and shallowness) to wind generated surges that can raise the water level along the shoreline by up to 2.5 meters for short periods (Horton 1927). They occur to a greater or lesser extent with a recurrence interval in the order of a year. A wind set of this magnitude, along with some of the other special conditions mentioned, would certainly cause flow through the divides, north to the first order stream channels of Twelve, Fifteen and Sixteen Mile Creeks (Figure 3). Also, it was mentioned earlier that there is no sign of scouring on the divides east and west of the Fonthill kame/delta. If these overflows were only active during exceptionally high levels of Lake Erie, then the flow depths over the divides would typically be only a meter or two, and the gentle slopes to the north and south would ensure flow velocities well below those needed to erode the fine silts and clay found in the area.

Effects on Native Habitation in the Southern Niagara Peninsula

At the outset of this paper, two quotes were presented which illustrated how important one's homeland is to humans, especially Native Americans. The data for the southern Niagara Peninsula indicates that, when Lake Erie levels rose first during the Agassiz phase (11,000 to 10,500 B.P.), and then during the Nipissing phase (5,500 to 3,900 B.P.), much of the southern Niagara Peninsula was innundated. Since the Niagara area has been continuously occupied for about 11,500 years, both lake rises would have displaced the established Native cultures occupying the flooded lands, forcing these people to relocate or perish. Of course, if it was only a matter of relocating, probably the cultures existing during these two periods would have had no trouble moving, since they were hunters and gatherers who typically moved on a regular, seasonal basis around a defined territory. However, it is not just a matter of picking up one's possessions and relocating that causes the most stress on a population, it is the fear of moving out of a known territory (an area where these people could fairly accurately predict what food resources would be available during the year), into a new region that may or may not be inhabited by another group, or may be a totally new environment in which prediction of food resource availability had to be learned from scratch.

Also, it was not just the fact that these groups had to contend with abandoning familiar lands for unfamiliar ones. The high water levels and formation of Lake Wainfleet also would have had dramatic effects on the local plant and animal communities. Change in lake level would have caused changes in the water table. Plants requiring drier environments in order to grow would die and it would take a considerable amount of time for damp environment plants to establish themselves in the area. Also, mammals, especially those generally territorial in their foraging ranges, would have been effected. As well, river-dwelling fish species do not normally survive when an area becomes a lake, and lake-dwelling fish which spawn in regularly defined areas have a great deal of difficulty re-establishing themselves in new spawning beds after a dramatic lake level rise.

Additionally, the chaos caused by two dramatic water level rises was also repeated by two water level declines, therefore the plant and animal populations of the southern Niagara Peninsula would have been in a constant state of flux for hundreds of years during and after each episode.

In short, the Native populations of the Niagara Peninsula had to respond to substantial changes which occurred in the region during the two high lake level periods, and would have had to be very resourceful to survive those changes. But, lake level flooding likely caused other problems for these Native occupants which would not have been easily recognized or associated with the flood. Certainly the flooding of land in northern Quebec by the huge James Bay hydro-electric complex has illustrated one such problem. There, vegetation inundated by the flooding began to decompose underwater, which led to the release of bacteria that in turn produced methyl mercury, which was then released into the water system. The methyl mercury would have then contaminated water plants and fish, with the effects of the mercury compounded as it passed up through the food chain. While the time required for vegetation to rot away and stop producing the bacteria may be from 10 to 20 years, mercury may remain in fish and amphibian populations for upwards of a hundred years. Ultimately, this mercury will be ingested by the people who continue to hunt and fish the tainted waters.

The peoples of the southern Niagara Peninsula may have experienced such problems after the Lake Erie floods, and for a Native population that requires good health, a keen mind and good reflexes in order to supply the basic necessities of life, the effects of mercury poisoning could be catastrophic. While difficult to test archaeologically, the production of tools from chert requires good hand/eye coordination in order to produce a functional projectile point. The results of mercury poisoning may have made this manufacturing process increasingly difficult. While no empirical studies have been done on this type of problem for the groups affected, it would be interesting to examine the knapping skills represented on sites occupied in the region during these periods of high lake levels.

Conclusions

While research into Lake Erie water level fluctuations is certainly only at the primary stage, the data presented here suggests that lake levels reached a height of 183 to 186 meters during the Agassiz phase, 11,000 to 10,500 B.P., and a level of 178 to 180 meters during the Nipissing phase, about 5,500 to 3,900 B.P. Both of these high water levels caused the formation of an ephemeral lake (Lake Wainfleet) between the Onondaga Escarpment and the Niagara Falls moraine - Fonthill kame, in the southern part of the Niagara Peninsula. During the Agassiz phase, two new, previously unrecognized outlets east and west of Fonthill probably carried water out of Lake Erie and Lake Wainfleet over the divide to the headwaters of the Twelve, Fifteen and Sixteen Mile Creeks, which flowed into Lake Ontario. Both the Agassiz and Nipissing lake level rises would have had catastrophic effects on the local plant, animal and human populations, and perhaps future research will be directed into these areas.

References

Bennet, G.
1978 **The Damned: The Plight of the Akawaio Indians of Guyana.** Survival International Document VI. London.

Clark, R. and N. Persoage
1970 Some Implications of Crustal Movement in Engineering Planning. **Canadian Journal of Earth Sciences 7: 628-633.**

Feenstra, B.
1981 Quaternary Geology of the Niagara Welland Area. Ontario Geological Survey, Open File Report Number 5361. Toronto.

1986 Niagara/Welland Quaternary Geology. Ontario Geological Survey Map Number 2496. Toronto.

Flint, J. and J. Lolcama
1985 Buried Ancestral Drainage Between Lakes Erie and Ontario. Bulletin of the Geological Society of America. Washington.

Fox, W. and J. Pengelly
1990 Prehistoric and Historic Settlement Patterns of the First Nation Along Lake Erie. Manuscript in the possession of the authors.

Goldsmith, E. and N. Hildyard
1984 The Social and Environmental Effects of Large Dams. Volume 1. Wadebridge Ecological Centre. Powrys, Wales.

Horton, R.
1927 Hydrology of the Great Lakes. (in collaboration with C. Grunsky). Report of the Engineering Board of Review, Sanitary District of Chicago, on the Lake Lowering Controversy, and a Program of Remedial Measures. Part 3, Appendix A. Chicago.

Kindle, E. and F. Taylor
1913 Niagara Folio. U.S. Geological Survey Atlas Number 190. Washington.

Larsen, C.
1985 Lake Level, Uplift and Outlet Incision in the Nipissing and Algoma Great Lakes. In: Quaternary Evolution of the Great Lakes (edited by P. Karrow and P. Calkin), pp. 64-77. Geological Association of Canada, Special Paper Number 30. Ottawa.

Lewis, C. and T. Anderson
1989 Oscillations of Levels and Cool Phases of the Laurentian Great Lakes Caused by Inflows From Glacial Lake Agassiz and Barlow-Ojibway. Journal of Paleolimnology 2.

Pengelly, J.
1990 Lake Erie Levels in the Northeastern Erie Basin and the Formation of Ephemeral Lake Wainfleet in Southern Niagara Peninsula During the Holocene Period. Unpublished B.A. Thesis, Department of Geography, Brock University. Thorold.

Stanford, B.
1956 Welland County, Ontario Showing Drift-Thickness and Bedrock Contours (Two Preliminary Maps). Department of Mines and Technical Surveys, Geological Survey of Canada Paper 55-20. Ottawa.

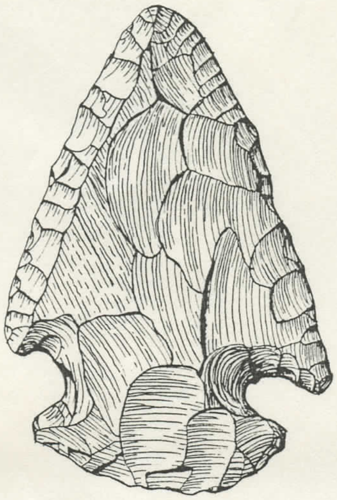
Teller, J.
1985 Glacial Lake Agassiz and its Influence on the Great Lakes. In: Quaternary Evolution of the Great Lakes (edited by P. Karrow and P. Calkin), pp.

1-16. Geological Association of Canada, Special Paper 30. Ottawa.

Teller, J. and L. Thorleifson
1983 The Lake Agassiz - Lake Superior Connection. In: Glacial Lake Agassiz (edited by J. Teller and L. Clayton), pp. 261-290. Geological Association of Canada, Special Paper 26. Ottawa.

Terasmae, J.
1980 Some Problems of Lake Wisconsin History and Geochronology in South-eastern Ontario. Canadian Journal of Earth Sciences 17: 361-381.

Tinker, K., J. Pengelly and W. Parkins
1990 Metres Matter: Lake Levels of Living Along the Erie Shoreline. Proceedings of the 12th Annual Niagara History Conference: 2-12.



THEBES POINTS

Size: Length= 40-64 mm (mean of 52 mm); Width= 24-40 (32); Notch Width= 15-21 (18); Base Width= 25-35 (30); Thickness= 5-13 (9).

Shape: The most prominent feature of the Thebes point is the hafting area. The stem is often large and sharply flaring. Heavy basal grinding is almost always present. The base is usually convex or straight, thick, and rounded leading up to the notch. The side or corner (from reworking?) notches are usually very deep and sometimes squared, and enter at an upward diagonal and inward inclination. The blade area is large and broad on unreworked specimens, and the edge can be serrated. This area, however, is often reworked, resulting in characteristic beveled edges and a rhomboidal cross-section. Blade edges are usually straight.

Flaking: Surface flaking is typically broad and shallow. Pressure flaking is concentrated at the blade edge and hafting area. Reworking of the Thebes point is executed by parallel pressure flaking on the blade edge on either the left or right side of both faces.

Raw Material: Points are most commonly made from local materials (50%+), with Bayport (25%), Upper Mercer (20%), and Flint Ridge (5%) also common in northwest Ohio.

Distribution: Thebes points are found over most of the Midwest (Bechtel 1988; Justice 1987), but are relatively rare in southwestern Ontario. Thebes sites tend to be concentrated to upland biotic zones such as terraces and fossil beach ridges.

Age: At present, only one site has yielded C-14 dates for Thebes points: 7750 B.C. and 6880 B.C. from the Graham Cave site. Based upon their position in stratified sites such as Graham Cave, Dillow and Duvan Rockshelters, a range of 8000-6000 B.C. has been suggested (Luchterhand 1970). In northwest Ohio a longer time range is suggested by the abundant use of Bayport chert, which is rare in Early Archaic assemblages but common in Middle Archaic ones, suggesting an end date in this region of perhaps 5000 B.C.

Comments: The large variation in metrics is due to extensive resharpening. Thebes-like bifaces have been found as knives, points and hafted scrapers, suggesting their use was as a specialized "heavy duty" tool, used and repaired until nothing was left.

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